A BRITISH INDEX OF NATIONAL PROSPERITY.

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Readers who have followed in the monthly Supplements of "The Economist" our endeavours to build up a series of indices of Current Business Activity will find much of interest in an attempt which has been made by Mr G. D. Rokeling to construct a single index number designed to measure annually our national prosperity. In this Supplement Mr Rokeling's work, to which Sir Josiah Stamp contributes a foreword of comment and appreciation, is published in abbreviated form. We propose to reprint the complete study as a pamphlet (price 2s 6d), which will include substantial passages of explanation and detail excluded from this supplement for considerations of space. In a leading article in this issue we deal generally with Mr Rokeling's conclusions.

CONTENTS.

		PAGE
Foreword		1
Introduction		1
Section 1.	The object of the investigation	1
„ 2.	The method of the investigation	2
„ 3.	What does national prosperity depend on?	2
„ 4.	How can national prosperity be measured?	3
„ 5.	The net imports of raw materials of the principal manufacturing industries	3
Section 6.	The number of workers	4
„ 7.	The consumption of coal	5
„ 8.	The index of production	6
„ 9.	The net real income from foreign investment	7
„ 10.	The index of population	8
„ 11.	The index of national prosperity	8
Appendix.	Comparison of the results with other data	8

FOREWORD.

It may be said that of the making of statistical indexes there is no end, and many graphs are weariness to the flesh. But, in fact, the use of these means in practical life is only in its infancy, for understanding must precede use, and it is not half a dozen years since a prominent City man asked me, "But what *is* an index number?" However, the price index and the cost of living index are now well understood, and the preaching of a few enthusiasts is bringing about a real attempt at an official index of *production,* which follows upon the publication of such an index by a private research body during the last few years. Now for some important purposes it is felt that a single statistical indication of the state of total national well-being is desirable.

It is obviously impossible to give any measure of prosperity in the absolute, so that an index of prosperity is of necessity an indication only of *fluctuations* in prosperity. This index is not actually the same as an index of production, for, to be added to material production, there are intangible services of all kinds, and it may even be contended that the lessening proportion of the total population engaged in producing physical products is a test of the advance of science and industry, and a growing proportion rendering personal services an evidence of greater civilisation. (Certainly, extension of the services of distribution and transport is often correlated with an economy in the *services* of pure production, where the advantages of mass production can only be obtained by a high degree of centralisation which involves distribution from that centre over a wide area.) Then there are the additions to our resources which come from net income from abroad, whether received as goods or services, or left there as increased savings. Again, a given increase may accrue to a stationary population, or it may follow growth in numbers, and ultimately represent a decrease *per capita.* In many other ways, too, a complete index of prosperity should reflect conditions which may escape a merely quantitative measure of output. For instance, a given number of hours of complete unemployment in some industries is not wholly made good by the same number of hours of overtime in others.

For a first attempt in this field the effort made by Mr Rokeling is very thorough and commendable. With the limited statistical resources at present available, he naturally disclaims any suggestion that the index which he has constructed is an ideal index, or can yield anything better than a rough picture. But he has handled the available material judiciously, and by methods which are calculated to give useful results. Whatever other index numbers may in the course of time be constructed before an ideal index is evolved, this pioneer work will be valuable and leave its impress upon the development of the subject. Unlike the Index of Prosperity for the Dawes Plan, this index is constructed with complete freedom from anterior influences or political exigencies, or particular aims, and it therefore is to be tested for a wide range of objects, and against all kinds of national considerations as the times demand.

J. C. STAMP.

INTRODUCTION.

THIS index of national prosperity is designed to show the degree of material well-being enjoyed by Great Britain and Northern Ireland as a whole over each year of the period 1920-7 relatively to the degree enjoyed in 1924.

The method of construction is explained fully and as far as possible in non-technical language in the following sections. Statistics of the volume of raw material worked up by industry, the number of productive workers, and the consumption of coal as the principal source of heat and power have first of all been combined to give an index of production. This index has then been combined with an index of net real income from foreign investment to give an index of real national income. These index numbers have then been divided by index numbers of population to give an index of real national income per head of the population, which for practical purposes is the measure of national prosperity. The index numbers of national prosperity work out as follows:—

(1924 = 100.)

1920	101	1924	100
1921	77	1925	100
1922	89	1926	91
1923	93	1927	105

The index cannot claim to furnish precise measurements of national prosperity; it does not pretend to be more than a rough picture. It can and does claim, however, to be a picture of which the general outline is accurate beyond a doubt; that is to say, to represent the general trend of national prosperity correctly.

1. THE OBJECT OF THE INVESTIGATION.

For the avoidance of industrial warfare, from which the country has suffered so grievously in recent years,

and the attainment of the higher standard of living which everyone desires, it is essential that there should be a better general understanding of the subject of national prosperity, what constitutes national prosperity, and the conditions upon which an increase is dependent. One of the obstacles to this wider understanding existing at present is the absence of any statistical record of national prosperity, a very serious gap in the statistical equipment of the country. The investigation, of which the results are given here, represents an attempt to fill this gap, so far as it is possible with the limited material at present available.

At any moment one place or industry may be thriving and another depressed, while the positions may be reversed a few months later. How is one to know how the country as a whole is faring and over the year as a whole? There is a mass of available statistics, but their interpretation is possible only to experts, and even so for the most part each set of figures tells only a small part of the tale. General impressions tend to be even less satisfactory, being coloured by temperament and the fact that adversity is always more vocal than prosperity, so that the impression is fostered that things are always much worse than they really are. The object of this investigation was, if possible, to provide something analogous to mean annual rainfall figures; to provide a series of figures, one for each year beginning with 1920, indicating the degree of material prosperity enjoyed by the country as a whole over the year as a whole.

2. THE METHOD OF THE INVESTIGATION.

An index of German prosperity on these lines figures in the Dawes Plan, and will determine the additional reparation payments, to be made by Germany annually as her prosperity increases, above and beyond the standard payments. The component statistics of the German index are:—

(1) The total of German imports and exports taken together.
(2) The total of budget receipts and expenditure taken together.
(3) The railroad traffic as measured by the statistics of the weight carried.
(4) The total money value of the consumption of sugar, tobacco, beer and alcohol within Germany.
(5) The total population of Germany.
(6) The consumption of coal (and lignite reduced to coal equivalent) per capita.

For each year the figure for each of the above components is to be expressed as a percentage of the figure for the base year, and the resulting percentages averaged to give the index number of prosperity for the year.

The composition of this index no doubt depended largely upon what statistics were available. It may also have been affected by political exigencies. Nevertheless, the underlying principle is clear, and the first stage in this investigation was to consider the possible ingredients of a similar index for the United Kingdom. This involved a review of the available statistics with a view to the selection of those which appeared *prima facie* to be suitable for the purpose. A list of possible ingredients having been obtained in this way, the next stage was to consider each of them in detail. This involved three problems. In the first place, it was necessary to obtain a series of figures for each year on a uniform basis, a problem which was much complicated by the separation of the Irish Free State. In the second place, it was necessary to determine what degree of error might be involved in the figures, and to reject any series of which the figures could not be shown to be reasonably accurate for practical purposes. In the third place, it was necessary to examine in detail the suitability of each series for inclusion in such an index. Many of the possible ingredients failed to survive these tests. This part of the work covered a very wide field and called for a detailed examination of a great mass of public statistics.

3. WHAT DOES NATIONAL PROSPERITY DEPEND ON?

It does not, of course, depend on such things as the level of prices or the budgetary surplus or the rate of income tax, as is sometimes supposed. National prosperity on the material side depends upon the real national income per head of the population, and may be represented for any year by the expression $(A + B)/C$, where A is the net output of goods and services in the year, B is the net real income accruing in the year from foreign investment, and C is the number of inhabitants of the country under consideration.

Experts will not require any explanation of this statement. For other readers the matter may be illumined by the following extract from Sir Josiah Stamp's "Wealth and Taxable Capacity" (chapter 2):—

> "I am most anxious that the conception of national income should be a living and real one to you all, and not merely a mass of figures, so may I put to you a homely and simple and, therefore, perhaps, inexact illustration, which may serve to make the matter more graphic? To many of you the idea will be fairly familiar; to others, perhaps, not so; but if you will really seize it, it will be one key for many other mysteries of production and exchange, and particularly of currency and the payment of war indebtedness. Will you suppose that all the services and goods that are produced by us as a community in a year are all piled in the centre of this room in a great miscellaneous heap. Every one of you, in the work that you do, is putting that work there. It includes the boots and the clothes that are made, the loaves that are baked, the sheep that are reared, the sermons that are preached, the songs that are sung, the physician's advice, the pilot's skill, the banker's knowledge, the business man's services of organisation, the crossing sweeper's service, indeed, everything that can be given by us whereby we have a claim upon the work of our fellow-men who are contributing to the heap, including the services of those who have helped to make the heap larger than it would or could be if we started afresh without the assistance of piled-up capital goods saved from the heaps of former years. Let it be supposed that we have no such thing as money, but that for each contribution we have made to the heap there is given to us a "labour or services ticket" with a claim to draw something out of the heap in return—if you like, for the moment, equivalent in its labour or equivalent in its skill or its sacrifice to what we have put in. The people who have refrained from an earlier consumption on the faith of their title to later consumption somewhat larger in extent, also have their title to the heap. Now the total of tickets giving titles to the heap will exactly equal the mass in the heap, and when we have all drawn out what we want of other people's products and handed in our tickets, the heap will have vanished. It is true that when we present our tickets we shall, perhaps, in our demands for a particular thing that is in the heap, exceed the actual supply; in other cases we may ask less. There may be fewer loaves put upon it than we want, and, perhaps, more servants and third-rate music hall songs than there is a demand for, but these are questions of bad anticipation of demand, and we must rule them out for the moment. The point is now that we cannot, as a whole, get more out of the heap than we have put into it."

To carry Sir Josiah Stamp's illustration a step further, "the national heap" which he invites us to envisage represents the year's gross output of goods and services. Of this, however, there must be set aside a part to pay for imports of raw materials, and another part for the maintenance of plant and other forms of capital including working capital. It is only the residue which is available for consumption (including exchange for foreign goods and services) and saving (including lending to foreigners). This residue is represented by the letter A of the expression $(A + B)/C$. Some of the contributors to the heap, however, are inhabitants of foreign countries, who are entitled to a share of it, not in return for work, but as lenders of capital goods which have contributed to its production. On the other hand, some of our people are similarly entitled to shares of foreign heaps. The balance of what is due in the year from foreign heaps to us over what is due from our heap to foreigners is represented by the letter B of the expression $(A + B)/C$. $A + B$ together represent the year's total supply of goods and services available for the satisfaction of the wants of the inhabitants of the United Kingdom. The number

of these inhabitants is represented by C. National prosperity obviously depends on the ratio of the available supply to the number of people amongst whom it has to go round, that is to say on (A + B)/C. As A + B is the real national income, *i.e.*, the national income in terms of goods and services, the money value of A + B being the national income in terms of money, national prosperity is seen to depend upon the real national income per head of the population.

4. HOW CAN NATIONAL PROSPERITY BE MEASURED?

One cannot measure the expression (A + B)/C absolutely, since one cannot add together picture houses, pocket knives, pork, pills, poetry, &c., and divide by population. The nearest one can get to an absolute measurement is to estimate the aggregate money value of the quantities of these things which are produced in a year. But this cannot be done for every year of the period 1920-7. Indeed, 1924 is the only year of this period for which the making of a reliable estimate has been possible. Although, however, the expression (A+B)/C cannot be measured absolutely, it is possible to measure the changes in it from year to year over a short period with a reasonable degree of accuracy. The method is as follows: The element C can be computed each year with a high degree of accuracy.

The element B is known to be very small relatively to A. Professor Bowley and Sir Josiah Stamp in "The National Income, 1924," put the money value of B at only about 4 per cent. of the money value of A + B together. The element B can be estimated roughly for each year, certainly within 10 per cent. of the mark. This is near enough, since a 10 per cent. error in B would involve an error of less than ½ per cent. in A + B together.

This brings us to A, the national heap of the preceding section. Let us examine its composition a little more closely. It consists predominantly of goods of all kinds, including capital goods like ships and dynamos, as well as the ordinary requirements of daily life like boots and bacon. The value of these goods at the stage at which they pass into the hands of the consumer or are shipped for export represents perhaps four-fifths of the value of the whole heap, and includes the value of the services rendered in connection with them by (*a*) producers (agriculture, mining, manufacture), (*b*) transport, and (*c*) distributors (wholesale and retail trade, &c.). In this sense these services may be said to be embodied in the goods. The residue of the heap, perhaps one-fifth by value, consists of what may be referred to as personal services in order to distinguish them from services of the former kind which are embodied in goods. To this category belong the volume of utilities produced by houses; the services of domestic servants, the professional classes, the central and local administrations, and the passenger transport system; also the balance of services rendered to foreigners by our shipping and by way of agency and commission after setting off services of this kind rendered by them to us.

Although the national heap cannot be measured absolutely, and 1924 is the only year for which a reliable estimate can be made of its aggregate money value, changes in its size from year to year during the period can be gauged from certain statistics which reflect them. This is the method underlying the German Index. These statistics are discussed in the four next following sections.

5. THE NET IMPORTS OF RAW MATERIALS OF THE PRINCIPAL MANUFACTURING INDUSTRIES.

If the producing industries carried on in the United Kingdom are divided into two groups, namely, (1) agriculture and fishery, mining and quarrying, public utility (e.g., gas) undertakings, and the industries engaged in the preparation of food, drink, and tobacco, and (2) the remainder, it is the industries of the second group with which this section is concerned, and which are referred to in it as the principal manufacturing industries. The group is rather the larger of the two in the sense that it makes the larger contribution to the national income. It is with the raw materials worked up by this group of industries that this section is concerned, and the term "raw materials" as used in it does not include coal, which is predominantly a fuel and is moreover dealt with in Section 7.

To ascertain precisely the quantity of raw materials consumed by these industries in a given year, it would be necessary to ascertain the quantity held in stock at the beginning of the year, the quantity imported and retained in the United Kingdom during the year, the quantity produced and retained during the year, and the quantity held in stock at the end of the year. For any one commodity, e.g., rubber, there may be a considerable difference between stocks at the beginning and end of a year; but over the whole range of raw materials of these industries it is highly improbable that this difference amounts to much except at the peak or trough of a trade cycle or in years which were otherwise abnormal like 1926. The United Kingdom is a small place geographically, and while it produces considerable quantities of certain raw materials, e.g., iron ore, wool, hides, and materials for the pottery and building industries, the 1907 Census of Production showed that these together represented only a very small proportion of the total quantity of raw materials consumed by the industries under consideration, the great bulk of which is imported from abroad. It follows that for these industries the net imports of raw materials in any year constitute a measure of the total quantity of raw materials consumed in the year; no doubt a rough measure, but nevertheless a measure which is generally regarded as satisfactory for practical purposes. It is also a reasonable assumption that the relation between the volume of goods produced by these industries and the volume of raw materials used in their production does not alter much from year to year over a short period of years. It follows that variations in the net imports of raw materials of the principal manufacturing industries may be taken as roughly reflecting variations during the period in the size of an important part of the national heap. Particulars of the volume of these net imports are as follows:—

NET IMPORTS OF RAW MATERIALS (including crude metals and undressed leather) AT 1913 VALUES.

	Million Pounds Sterling.	Percentage of 1924.
1920	211·7	102·0
1921	138·4	66·7
1922	177·0	85·3
1923	181·0	87·2
1924	207·6	100
1925	223·5	107·7
1926	231·8	111·7
1927	236·5	113·9

The above figures are compiled by the Board of Trade. They represent, for each year commencing with 1920, the total value of the imports retained in the United Kingdom of all articles except coal included in Class II. (Raw Materials and Articles Mainly Unmanufactured) of the official trade returns, together with crude metals and undressed leather, which, though included in Class III. (Articles Wholly or Mainly Manufactured), are raw materials from the point of view of the industries which use them. With the object of eliminating the effects of price changes, and thus of presenting a picture of the total volume of retained imports in each year, the values given are not the actual values as declared in each year, but the values resulting from revaluing the quantities as declared in each year at the average value per unit recorded in 1913.

The application of this method to the articles covered by the table is not open to the objection attaching to its application to highly manufactured articles. A ton of raw jute or a cubic foot of hewn mahogany is much the same thing now as it was 5, 10, or 15 years ago, but this cannot be said for instance of a ton of electrical machinery, as goods now declared as such may well be more highly manufactured and therefore more valuable products than goods passing under this description in 1913. Among manufactured goods which are now exported there are also kinds and designs which did not exist in 1913.

For the purposes of the official trade returns the term "the United Kingdom" meant Great Britain and the whole of Ireland up to April 1, 1923. From that date however, it means Great Britain and Northern Ireland, and the Foreign Trade Returns of the United Kingdom include the trade of Great Britain and Northern Ireland with the Irish Free State, and exclude the trade of the Irish Free

State with countries other than Great Britain and Northern Ireland. So far as concerns the articles covered by the table, however, the effect of this change can be shown to be negligible for practical purposes, and the figures may be regarded as relating throughout to one and the same geographical area, viz., Great Britain and Northern Ireland.

Though the figures, for practical purposes, are on a uniform basis and represent reasonably accurately what they purport to represent, viz., the volume of retained imports each year, the assumption that they also constitute a measure of production requires some qualification. No appreciable error arises from the non-inclusion of raw materials produced and retained at home, as the volume of the latter is relatively small and subject to comparatively little variation. But owing to the impossibility of allowing for stocks, as measures of the actual consumption of raw materials, the figures for 1920 and 1926 are probably too large, and the figures for 1921 and 1927 too small. It is reasonable to assume some accumulation of stocks in 1920, which began with industry in full swing and ended in serious depression. Much of this accumulation was probably worked off in 1921. In 1926, again, there was probably some accumulation of stocks, as it is believed that large purchases were made in anticipation of a brisk industrial revival after the coal strike; the accumulation was no doubt worked off in 1927. One other important qualification must be made. It is the business of industry to be constantly devising new methods and constantly improving its technique. This may have the effect of making a given quantity of raw material go further; everyone is constantly striving to reduce his costs of production. Or it may have the effect of producing goods of finer workmanship; general evidence supports the idea that the tendency in this direction, long-established in this country, still continues. Or it may lead to the utilisation of what were formerly waste-products. These tendencies are undoubtedly at work, with the result that any figures representing the annual consumption of raw materials of industry over a series of years must progressively underrepresent the size of the national heap, so far as it consists of the products made out of these raw materials, in the later as compared with the earlier years. Over so short a period as 1920-27 this under-representation is probably small, but any attempt to compare present and prewar conditions by this method would be seriously misleading.

6. THE NUMBER OF WORKERS.

The quantity of goods and services produced in a year obviously depends upon the number of persons functioning as productive workers during the year, though the number of hours worked and the output per man-hour are also factors which must be taken into account. The number of hours worked depends upon the normal length of the working week and the extent to which this is increased or diminished by overtime or short-time. Output per man-hour depends upon a variety of considerations, for instance, organisation. It is a matter of common knowledge that an improvement in works organisation will often increase the output per man-hour of the works as a whole. It also depends on machinery and processes. There is a constant tendency for these to improve with the accumulation of capital and progress of science and invention, and, as they improve, to increase the productivity of labour. Finally it depends upon the spirit which workers bring to their work. Hard work makes a wonderful difference to output.

Upon the assumption, which will be examined further on, that so far as the period 1920-7 is concerned there has been no very great change from year to year in the number of hours worked or the output per man-hour, it is evident that a series of figures representing for each year the number of persons functioning during the year as productive workers will give a rough picture of the size each year of the national heap. Such a picture of a large portion thereof is given by the last two columns of the following table:—

	Number of Insured Workers. (Thous'nds)	Number of Agricultural Workers (Thous'nds)	Number of Unemployed. Thousands	Time Lost by Trade Disputes (Reckoned in Persons). (Thous nds	Number of Productive Workers. Total [Cols. (1) + (2)—(3)—(4)] (Thousands)	Number of Productive Workers. Index Numbers (1924=100)
	(1)	(2)	(3)	(4)	(5)	(6)
1920	10,859	975	334	86	11,425	102·4
1921	11,081	996	1,859	285	9,932	89·3
1922	11,181	944	1,684	65	10,376	93·3
1923	11,232	892	1,321	35	10,769	96·9
1924	11,404	924	1,182	28	11,118	100
1925	11,623	925	1,397	26	11,225	101·0
1926	11,774	921	1,467	541	10,687	96·1
1927	11,876	900	1,182	5	11,588	104·2

The foregoing table relates throughout to Great Britain only. Column 1 shows the gross numbers insured under the Unemployment Insurance Acts (page 46 of the Eighteenth Abstract of Labour Statistics). The figures for 1921 and subsequent years are strictly comparable, as the scope of the Acts as regards the classes of persons covered has not altered since they were introduced in November, 1920, and the method of compilation of the figures, which rest upon ascertainments made each July, has been uniform throughout. The figure for 1920 is an estimate based upon consideration of the size of the age-groups disclosed by the 1921 Census and of the larger number of men serving in H.M. Forces in 1920 as compared with 1921, and errs, if at all, on the side of excess.

Column 2 shows the number of agricultural workers employed on agricultural holdings, and is based on the statistics of the Ministry of Agriculture for England and Wales and the Board of Agriculture for Scotland.

The figures, except for 1920 and 1922, are strictly comparable throughout, being compiled upon a uniform basis and representing the position at the Agricultural Census held on June 4th of each year. No ascertainment was made in 1920 and 1922. The figure taken for 1922 is the mean of the figures for 1921 and 1923. That for 1920 is an estimate obtained by adjusting the 1921 figure, on the one hand for the larger number of men serving in H.M. Forces in 1920, and on the other hand for the larger proportion of arable land in cultivation in 1920, and errs, if at all, on the side of excess.

The figures in Column 3 are the sum of two elements—(*a*) insured workers unemployed and (*b*) agricultural workers unemployed. The figures for (*a*) are the yearly averages of the monthly averages given on page 51 of the Eighteenth Abstract of Labour Statistics, and are compiled upon a uniform basis throughout, except the figure for 1920, which is an estimate obtained by applying an unemployment rate of 2.8 per cent. to the figure in the first column. This rate is obtained by taking the trade union rate of unemployment for 1920 (2.4 per cent.) and increasing it by one-sixth, which is the approximate average difference between the two rates in subsequent years. The estimate of insured workers unemployed in 1920 errs, if at all, on the side of understating the volume of unemployment in that year. The figures for (*b*) are obtained by applying an assumed uniform rate of 2 per cent. to the figures in the second column. The rate of unemployment among agricultural workers is subject to little variation from year to year. On the basis of the available information, the rate assumed, 2 per cent., cannot be far from the mark.

The figures in column 4 are derived from the Ministry of Labour's statistics of the aggregate duration in man-days of all disputes involving stoppages of work which were in progress each year, and are obtained by dividing the aggregate duration for the year by the number of working days in the year. They are on a uniform basis throughout. There is no duplication between these figures and those in column 3.

The number of productive workers in column 5 is found by adding the numbers in columns 1 and 2 and subtracting therefrom the numbers in columns 3 and 4. In column 6 the number of productive workers in each year is expressed as a percentage of the number in 1924. The totals of columns 1 and 2 represent persons of whom the great majority form the great bulk of the manual workers in industry, agriculture, transport, and the distributive trades. They include all workers, male and female, who exchange their products or labour for money except the following categories (*a*) non-civilians, (*b*) employers, (*c*) persons working on their own account, (*d*) juveniles under 16 other than those employed on agricultural holdings, (*e*)

persons employed otherwise than by way of manual labour at a rate of remuneration exceeding in value £250 a year, (*f*) persons employed in domestic service, and (*g*) certain classes of persons within the scope of the Unemployment Insurance Acts who are specially exempted from their operation. The total of columns 1 and 2 for 1921, viz., 12,077,000, represents nearly two-thirds of the total number of persons in Great Britain returned as occupied at the 1921 Census. The remaining third is accounted for by the categories (*a*)—(*g*) above. There is no evidence that this proportion between the number of persons in categories (*a*)—(*g*) and the numbers included in columns 1 and 2 of the table has undergone any appreciable change during the period under review. It follows that one is justified in using the figures in column 6 as rough measures of the total number of persons functioning each year as producers of a definite and very large portion of the national heap. Indeed, one might perhaps go further and use them as rough measures of the total number of persons functioning each year as productive workers of all kinds in Great Britain, were it not for the fact that the rate of unemployment has been much lower in categories (*a*)—(*g*) than in the categories covered by the table.

It remains to consider how far the figures in column 6 can be regarded as reliable measures of production. This depends on the average length of the working week, overtime, short-time, and output per man-hour. It has been shown by Mr J. W. F. Rowe in the London and Cambridge Economic Service Special Memorandum No. 8 (page 10) that the treatment of all workers as of equal productivity does not involve any error, since differences of skill and in the net product per worker in different industries cancel out over so vast a field.

The Ministry of Labour's statistics show that in the years 1921-1926 there was practically no change in the average length of the working week. In 1920 and 1927 it was somewhat longer, but the difference would add less than a unit to the index number for 1927 in column 6, and less than half a unit to that for 1920.

With regard to overtime, there is very little information. As to short time, it is probable that in abnormal years like 1921 and 1926 there was a great deal of short time, also of lost time and under-employment such as occurs in the cotton industry when a worker tends only two looms instead of three or four, and that consequently the index numbers in column 6 for these years, regarded as measures of production, are too high, even though the figures in column 3 take account of short time so far as persons working short time claim unemployment benefit.

When the system of short-time working consists of suspensions for one, two, three or more days per week, the operatives generally claim benefit. When it consists of a reduction in the daily number of hours worked, no record is obtainable at the employment exchanges, because no benefit is paid for any day on which work is performed. At one time certain trades used to adopt the former method, and others the latter, but since 1920, in order to obtain as much advantage as possible from the Unemployment Insurance Acts, the practice of organising short time by suspensions for one or more complete days has largely increased.

On a review of all the evidence, and bearing in mind that errors tend to cancel out over so large a field, it is improbable that the index numbers in column 6 would be much affected, if due allowance were made for overtime and short time, except in the years 1921 and 1926, for which, as explained, they are probably too high.

As regards output per man-hour, it is humanly speaking certain that there has been a slow progressive increase during the period under review with improvements in organisation, machinery, and processes. The index numbers in column 6 to this extent under-represent production in the later as compared with the earlier years of the series, but in a period of only eight years the degree of under-representation on this account is probably not large.

It may seem surprising that, with a higher rate of unemployment in 1927 than 1920, there was also more employment. The paradox disappears when it is borne in mind that there were some 200,000 more men in H.M. Forces in 1920 than there were in 1927; also that the new entrants each year since 1920 into the ranks of workers have greatly outnumbered the losses through death, old age, emigration, &c.

7. THE CONSUMPTION OF COAL.

Coal is the principal source of heat and power in industry and transport. Assuming for the moment that the relation between a given quantity of coal and the number of units of heat and power derived from it does not alter much over a short period, and assuming also that the annual consumption of coal for domestic purposes has been stationary in recent years, it will be seen that, over a short period, variations in the annual consumption of coal may be taken as roughly reflecting variations in the annual consumption of heat and power in industry and transport. These in turn, assuming for the moment that the relation between a given number of units of heat and power and the quantity of goods and services produced with their assistance does not alter much over a short period, may be taken as roughly reflecting variations in the size of that part of the national heap which is contributed by industry and transport. Hence the annual consumption of coal year by year over the period 1920 onwards may be taken as a rough measure of the size of a very large part of the national heap.

This method, however, involves under-representation of the size of the national heap in later as compared with earlier years, as will be apparent from the following considerations. In the first place, there are other sources of heat and power besides coal. The increase in the annual consumption of fuel oil since 1920 is equivalent at a moderate computation to half a million tons of coal; there has also been an enormous increase in the use of motor spirit for transport. Secondly, methods of converting coal into heat and power are constantly improving. Thus in electricity works the average consumption of coal per kilowatt hour is steadily decreasing, having fallen from 3·47 lbs in 1918 to 2.53 lbs in 1925; in gas works the average yield of gas from a ton of coal has increased from about 65 therms to 72 therms in the last 20 years. Thirdly, it is reasonable to assume a progressive improvement during the period in the methods of application of heat and power and in the efficiency of manufacturing processes. For instance, there has been a good deal of scrapping of older and less economical iron and steel plants in recents years; while the effect of the growing use of electricity in industry and transport is to reduce the quantity of coal required to produce a given quantity of power. All these factors operate in the same direction, with the result that figures representing the annual consumption of coal since 1920 must necessarily seriously under-represent the size of the national heap in later as compared with earlier years.

Particulars of the annual consumption of coal are as follows :—

	1920.	1921.	1222.	1923.	1924.	1925.	1926.	1927.
Million tons	180·7	127·0	157·8	168·8	180·4	169·6	130·5	179·6
Percentage of 1924....	100·2	70·4	87·5	93·6	100	94·0	72·3	99·6

The above figures (except those for 1921), derived from the official publications of the Mines Department, relate to Great Britain only, the necessary adjustments having been made in respect of shipments to and from Ireland.

The method of their construction is as follows. To (A) the home production of saleable coal there is added (B) the tonnage of coal and coal-equivalent of coke and manufactured fuel imported and retained. From this total there is subtracted (C) the tonnage of home-produced coal and coal-equivalent of coke and manufactured fuel exported and (D) the tonnage of home-produced coal and coal-equivalent of manufactured fuel shipped for the use of steamers engaged in foreign trade.

The Mines Department did not give a figure for 1921, but a fairly close estimate can be made from the available information, and is given above.

The figures may be regarded as on a uniform basis and accurately representing actual consumption, subject to the following considerations. Except in 1926 no account is taken of variation in the volume of stocks as between the beginning and end of each year. For 1920 and 1922-5, however, the Mines Department consider such variation to be negligible for practical purposes. For 1926, in their

total of 130½ million tons they have included an allowance for depletion of stocks consequent upon the coal stoppage. In 1927 there was some replenishment of stocks, and their figure of 179.6 million tons, which takes no account of this, as a measure of actual consumption, is therefore somewhat too high. Up to and including 1922 the figures rest upon home production figures which are on a slightly different basis from that employed for later years, and on the latter basis would have been rather smaller. Moreover, during the war and the years immediately following it the condition of the coal supplied was much poorer than usual, the abnormal amount of "dirt" or refuse included in it being the subject of much complaint in Parliament and the Press. There has been an improvement in this respect since 1920. There has probably also been a progressive improvement in the efficiency of washing processes. These last three factors all tend to exaggerate the apparent consumption of coal, and thus to over-represent the size of the national heap, in the earlier as compared with the later years of the series. As between 1920 and 1927 this exaggeration probably amounts to as much as 1½ million tons.

The various main uses of the coal are shown in the following table, reproduced from the Sixth Annual Report of the Secretary for Mines, which also serves to illustrate the extent of the dependence on coal of industry and transport.

(Consumption in Million Tons.)

	1920.	1922.	1923.	1924.	1925.	1926.
1. Gas works	16·9	15·2	15·4	16·7	16·5	16·7
2. Electricity generating stations belonging to authorised undertakings and to railway and tramway authorities	7·4	6·5	7·2	7·7	8·1	8·6
3. Railway companies (for locomotive use)	13·4	12·2	13·3	13·5	13·4	11·4
4. Vessels engaged in the coastwise trade (bunkers)	1·3	1·2	1·2	1·3	1·2	0·7
5. Iron works (pig-iron)	18·6	9·5	14·4	14·2	12·0	4·7
6. Steel and iron works (other than pig-iron)	11·6	8·0	11·3	10·3	9·3	
7. Collieries (engine fuel)	17·2	16·3	16·9	16·6	15·4	
8. Domestic coal, including miners' coal (approximate)	40·0	40·0	40·0	40·0	40·0	88·5
9. General manufactures and all other purposes	54·0	48·9	49·1	60·1	53·8	
	180·7	157·8	168·8	180·4	169·6	130·5

Domestic consumption falls under head 8; there is also some domestic consumption included under heads 1 and 2. That it has remained stationary, notwithstanding the growth of population (nearly 4 per cent. between 1920 and 1927), is doubtless due to economy in the use of coal as the result of the maintenance of relatively high prices for domestic qualities, to central heating and improved grates, and to the increased use of gas for cooking and heating purposes. The increased use of gas and electricity for domestic purposes is believed to have been offset as regards its effect upon the consumption of coal by improvements in the technique of manufacture and economies resulting from enlargement of the size of undertakings.

It is evident that figures more nearly representing the consumption of coal by industry and transport can be obtained by excluding the tonnage under head 8 of the foregoing table. This amounts to 40 million tons in round figures in a normal year, and may be put at 35 million tons in 1921 and 30 million tons in 1926, for which years precise information is not available. The tonnage under head 8 is accordingly excluded in the following table. It has also been seen that the figures thus obtained will seriously under-represent the size of the national heap in the later as compared with the earlier years of the series, and that something must be done to correct this, or the figures will be misleading. It is no use attempting to form a precise estimate of the degree of under-representation, since the data are insufficient. On the other hand, it is possible to form a minimum estimate, such as is not likely to be challenged on the ground of being excessive, and to correct accordingly the figure representing the consumption each year by industry and transport. This is done in the following table, in which the annual consumption figure has been adjusted, on account of all causes of under-representation together, by the addition of ½ per cent. for 1921, 1 per cent. for 1922, 1½ per cent. for 1923, 2 per cent. for 1924, and so on progressively. For 1927 this makes an addition of 4.9 million tons. In this way one obtains the following figures, which may be taken as roughly reflecting the size of the national heap each year, so far as it can be gauged from the consumption of coal. Even with the allowance which has been made for under-representation, the figures probably still rather under-represent the later years:—

	Million Tons.	% of 1924.		Million Tons.	% of 1924
1920	140·7	98·3	1924	143·2	100
1921	92·5	64·6	1925	132·8	92·7
1922	119·0	83·1	1926	103·5	72·3
1923	130·7	91·3	1927	144·5	100·9

8. THE INDEX OF PRODUCTION.

Each of the three series of the foregoing sections gives a rough partial picture of the national heap. They possess the requisite degree of correlation. A very high degree of correlation is not to be expected, since they none of them cover quite the same parts of the national heap, and the coal series necessarily gives too much weight to the fortunes of those industries which are the largest coal consumers, *e.g.*, the iron and steel industry. As a fact, between 1920 and 1924, the correlation between all three series is close. The increase in the value of sterling, which came about in 1925 with the restoration of the pre-war parity between sterling and gold, gave a fillip to external purchases of raw materials for conversion here into home-consumed articles. This is reflected in the raw materials index number for that year. On the other hand, it produced a corresponding set-back in exporting industries subject to foreign competition like the iron and steel industry; this set-back is reflected in the index number for coal. It remains to combine the three series so as to give a single picture.

Of the three series, that for raw materials relates to Great Britain and Northern Ireland and the other two to Great Britain only. As, however, Great Britain contributes more than 97 per cent. of the population of Great Britain and Northern Ireland, the assumption that the two latter series also refer to Great Britain and Northern Ireland, which is made for the purpose of combining the three series, cannot involve more than a trifling error.

The first series, reflecting the output of the principal manufacturing industries and indirectly also the volume of services rendered in connection with its transport and merchanting, relates to a smaller portion of the national heap than either of the other two. This can be appropriately allowed for by using the weights 1, 2 and 2 in combining the three series. The well-known principle that very great precision in weighting is not essential to secure a general index number of satisfactory exactitude from a number of partial indices which are themselves reliable in character may be recalled in this connection. Combined in this way, with 1924 taken as the base year so as to link up the results of this investigation with the results of the recent census of production, the three series gives the following index of production:—

Year.	Net Imports of Raw Materials of the Principal Manufacturing Industries. (Weight = 1.)	Number of Workers. (Weight = 2.)	Consumption of Coal. (Weight = 2.)	Index of Production. (Columns (2), (3) & (4) Combined According to the Weights Shown at the Head of Each.)
	(1)	(2)	(3)	(4)	(5)
1920	102·0	102·8	96·3	100·8
1921	66·7	89·3	64·6	74·9
1922	85·3	93·3	83·1	87·6
1923	87·2	96·9	91·3	92·7
1924	100	100	100	100
1925	107·7	101·0	92·7	99·0
1926	111·7	98·1	72·3	89·7
1927	113·9	104·2	100·9	104·8

Any error arising from the fact that the component series probably record too high for one or two years and too low for one or two others, as already explained, may fairly be regarded as eliminated by the process of combination, except in the case of 1926. Two of the three component series probably record too high for 1926, without any compensation from the third, with the result that the index number of production (89.7) is probably too high in relation to other years. The tendency to under-representation, which has already been noted in each of the component series, is necessarily present in the index of production also. This means that going back from 1924 the index numbers of production tend to be progressively too

large, and—going forward from 1924—progressively too small. That is to say the index presents a conservative picture of progress. The error thus introduced cannot be large over a period of the duration and character of 1920-7. It may well, however, amount to as much as ¼ per cent. per annum, equivalent to 25 per cent. in 100 years. The productivity of labour is known to have increased faster than this in the interval between the census of production of 1907 and that of 1924.

The foregoing index of production is for practical purposes an index of the volume of goods reaching the consumer for consumption or saving or the docks for export, and covers some four-fifths of the national heap (Section 4). How would it differ from an index covering the whole heap? This question involves an examination of that part of the national heap which has been labelled personal services. In so far as the demand for these services springs directly from persons engaged in the production, transport and marketing of goods, who in effect exchange their goods for these services, it is clear that the volume of personal services produced annually must tend to vary with the volume of goods produced annually. This applies particularly to the services performed by the professional and artistic classes. Everyone knows that work at the Bar is slack in periods of trade depression, and that the fortunes of artists and entertainers depend upon the amount of spare money in our pockets. The position of domestic servants is somewhat different. The volume of opportunities open to women in works, businesses and offices expanded phenomenally during the war, with the result that at the end of it there was an acute shortage of domestic servants. The return to more normal conditions witnessed a contraction in the volume of competing opportunities, and there is reason to believe that the number of domestic servants has been on the up-grade since 1919. The value of the utility which a house produces annually is the rent. The volume of utilities produced annually by houses, a very important element in this part of the national heap, depends on their number and quality. It is clear from the statistics of the Ministry of Health that there has been no contraction in this volume during the period 1920-7; indeed, some expansion is probable. A rough picture of the variation in the volume of shipping services rendered annually to foreigners may be obtained by comparing the Board of Trade's annual estimates of national income from shipping services with the course of freight and time charter rates; the variation is found to resemble that of the index of production. The various services just discussed together constitute perhaps some four-fifths of the part of the national heap labelled personal services. Although this part does not lend itself to statistical measurement, enough has been said to make it clear that, if an index of personal services could be constructed and combined with the index of production of goods by means of appropriate weights (1 and 4), for the period 1920-7 the resulting index would differ from the index of production of goods only very slightly—the curve would be slightly flatter; that is to say, the index numbers for 1920 and 1927 would probably be slightly lower than those in the last column of the preceding table, and those for 1921, 1922, 1923 and 1926 slightly higher. For practical purposes, therefore, one is justified in using the index of production of this section as a rough picture of the variation in the size of the whole national heap.

One other matter must be mentioned here. About a quarter of the whole of our produce and manufactures is exported. The foreign balances thus acquired are used largely to purchase imports. For instance, we send India locomotives, and she sends us tea. If the prices which we are able to get for our exports rise relatively to the prices which we have to pay for our imports, with the same volume of exports we can command a larger volume of imports, that is to say there is a rise in the real ratio of exchange between our exports and imports, and the result is the same as if there had been an increase in the size of the national heap; and *vice versa*. The course of the real ratio of exchange may be seen by comparing on the one hand the Board of Trade index of the values of exports and the course of freight and time charter rates (as exhibited in any of the well-known indices) and on the other hand either the Board of Trade index of the values of imports or the Board of Trade index of wholesale prices. The comparison shows that there has been practically no change in the real ratio of exchange during the period 1920-7, except that in 1920 our shipping services rendered to foreigners, though small in volume as compared with the other years, exchanged about twice as favourably. But adjustment for this circumstance would add less than a unit to the index number of production for that year.

9. THE NET REAL INCOME FROM FOREIGN INVESTMENT.

Year.	Board of Trade Estimates. (Million Pounds Sterling.)	Excess of Government Payments. (Million Pounds Sterling.)	Net Money Income from Foreign Investment. (Million Pounds Sterling.)	Index Numbers of Wholesale Prices. (1913 = 100.)	Index of Net Real Income from Foreign Investment. (1924 = 100.)
(1)	(2)	(3)	(4)	(5)	(6)
1920..	200	5	195	307	51
1921..	200	— 41	241	197	98
1922..	200	14	186	159	93
1923..	200	23	177	159	89
1924..	220	12	208	166	100
1925..	250	9	241	159	121
1926..	270	2	268	148	145
1927..	270	0	270	141	153

The figures in column 2 of the above table, except that for 1921, are taken from the Board of Trade's estimates of "the balance of trade" presented annually in the *Board of Trade Journal*. They represent the interest and dividends which we in the United Kingdom receive on our investments abroad, *i.e.*, on the money which we have loaned to India, the Dominions and Colonies, and foreign countries, or invested there in railways, oil fields, plantations, mines, trading concerns, and in a hundred other ways—after setting off the interest and dividends which people abroad receive in respect of their investments in the United Kingdom.

For the abnormal year 1921 the Board of Trade did not attempt an estimate of "the balance of trade," but one cannot be far out in taking £200,000,000 for that year in column 2, the same figure as in 1920 and 1922. The figures in column 2 are based mainly on information in the hands of the Inland Revenue authorities. Quite recently Sir Robert Kindersley, as President of the National Savings Committee, instituted an independent investigation, with the aid of some 60 banks and 160 British companies operating abroad, into the subject of our net income from foreign investment in 1927. His results confirm the Board of Trade's figures for that year, and, in establishing independently that their method gives an accurate figure in a particular year, must be held greatly to diminish the margin of possible error in their figures for other years. The significance of Sir Robert Kindersley's results were referred to by the President of the Board of Trade in the House of Commons on June 12, 1928. For practical purposes the figures in column 2 may be regarded as lying certainly within 10 per cent. of the mark and probably nearer. This is near enough for the purpose in view as explained in Section 4. The figures do not take account of direct receipts and payments by the Government.

The figures in column 3 are derived from the Finance Accounts of the United Kingdom. They represent the excess of Government payments belonging to the category of income from foreign investment over Government receipts belonging to the same category. The payments are in respect of interest on war debt, principally the American debt. The receipts include interest on war loans to the Dominions, Colonies and Allied Powers, German Reparation receipts, interest on loans for reconstruction, &c., interest on Colonial advances, and interest and dividends from the Suez Canal and Anglo-Persian Oil Company. The figures relate to the financial year, and have been assigned to the calendar year to which the financial year most nearly corresponded. They may be regarded as accurate for practical purposes. That for 1927 is an estimate. The excess of receipts over payments in 1921 was due to the large sum received from the Reparation Commission.

The figures in column 4 are obtained by deducting those in column 3 from those in column 2, and represent the net money income from foreign investment accruing to the United Kingdom year by year. The real income corresponding to a given money income, however, underwent great variation during the period, owing to the great variation in the purchasing power of sterling over commodities which form the subject of international trade. This variation is exhibited in the Board of Trade's index numbers of wholesale prices given in the fifth column. To obtain a picture of the variation of the net real income from foreign investment year by year, it is necessary to eliminate the effects of the variation in the purchasing power of sterling by dividing the figures in the fourth column by those in the fifth column. The quotients, expressed as percentages of the quotient for 1924, are the index numbers of net real income from foreign investment given in the sixth column. The figures cannot claim to be more than rough estimates, but the degree of error to which they are subject is not more than 10 per cent., and is not large enough to affect the main outline of the picture which they present, which is one of remarkable progress.

10. THE INDEX OF POPULATION.

The following index numbers (1924 = 100), based upon the official estimates of the General Register Office, may be taken as representing accurately for all practical purposes the number of inhabitants of Great Britain and Northern Ireland. The method of construction is explained in the full work.

1920.	1921.	1922.	1923.	1924.	1925.	1926.	1927.
97·6	98·1	98·8	99·3	100	100·4	100·8	101·3

11. THE INDEX OF NATIONAL PROSPERITY.

We have now obtained measurements of the variation of the expressions A, B and C (Section 4). It remains to combine them so as to obtain a measurement of the variation of the expression (A + B)/C; that is to say, it remains to combine the index of production (Section 8), the index of net real income from foreign investment (Section 9), and the index of population (Section 10), so as to give an index of national prosperity.

The first step is to combine the index of production and the index of net real income from foreign investment, using for this purpose the weights 96 and 4, which represent the relation between the values of the two elements in 1924, according to Professor Bowley and Sir Josiah Stamp in "The National Income, 1924." The result is the index of real national income appearing in column 4 of the following table. It may be mentioned that the reason why the German Index takes no account of income from foreign investment is that Germany's income from this source is inconsiderable, thanks to the losses which she sustained through the war.

The framers of the German Index were less concerned with the standard of living in Germany, than with the growth of her production. They therefore framed what is really an index of production, using population as an ingredient, presumably because better information with regard to the number of workers was lacking. This method is inapplicable to the present investigation, which is concerned with the internal standard of living, for the representation of which it is necessary to divide resources by population. Obviously, if in one year there are twice as many people as in another, with the same quantity of things to go round, the country will be very much less prosperous in the former year than the latter. Whether it will be exactly half as prosperous depends amongst other things upon the distribution of the national income among the various sections of the community and upon the age—and sex—distribution of the population in the two years. Over a period as short as eight years, however, such considerations as these may be safely disregarded, and satisfactory index numbers of prosperity may be obtained by dividing each year's index number of real national income by the index number of population, and expressing the result as a percentage of the result for 1924. The index of national prosperity, thus obtained, is given in the last column of the following table:—

Year.	Index of Production. (Weight = 96.)	Index of Net Real Income from Foreign Investment. (Weight = 4.)	Index of Real National Income. (Columns 2 and 3 Combined According to the Weights Shown at the Head of Each.)	Index of Population.	Index of National Prosperity. Col. 4 / Col. 5 × 100
	(2)	(3)	(4)	(5)	(6)
1920..	100·8	51	98·8	97·6	101·2
1921..	74·9	98	75·8	98·1	77·3
1922..	87·6	93	87·8	98·8	88·9
1923..	92·7	89	92·6	99·3	93·3
1924..	100	100	100	100	100
1925..	99·0	121	99·9	100·4	99·5
1926..	89·7	145	91·9	100·8	91·2
1927..	104·8	153	106·7	101·3	105·3

The above index numbers of national prosperity, based as they are only on rough measurements of production and net real income from foreign investment, cannot claim to be precise measurements of national prosperity; the index is far from being a perfect index. They can and do claim, however, to be satisfactory rough measurements of national prosperity—in fact, to constitute a picture of which the main outline is accurate beyond a doubt. In this respect they are like the Board of Trade's index numbers of wholesale prices. No one supposes that this index furnishes precise measurements of the level of wholesale prices, an abstraction which indeed is incapable of being measured precisely. Yet no one doubts that it reflects the trend of wholesale prices accurately. The development of our statistical resources must proceed a long way before an ideal index of national prosperity can be evolved.

The grounds on which the index of national prosperity lays claim to public confidence are threefold. In the first place it is constructed upon methods which accord with the established principles of economic science and for which there is the high authority of the Committee of International Experts presided over by General Dawes. In the second place it is based upon public statistics which are known to be free from any gross error. In the third place, as will be shown in the Appendix, it agrees with other evidence bearing upon the subject.

The close resemblance between the second and sixth columns of the foregoing table will be noted. In other words the growth of the net real income from foreign investment has been about off-set as a factor in national prosperity by the growth of the population; so that for practical purposes, during the period 1920-7, prosperity may be measured by production.

In conclusion, grateful acknowledgments are due to Sir Josiah Stamp, Mr W. T. Layton, and to Professor Gregory and Mr J. W. F. Rowe of the London School of Economics, for advice upon the general lines of the index, and to the many friends who lent a hand with the vast mass of detail.

G. D. ROKELING.

APPENDIX.

In the reprint will be found a comparison in detail between the figures of Mr Rokeling's index number and the results arrived at by other investigations into the volume of production. A summary of the comparison is given in the following table:—

	Index of Production of Section 8.	Board of Trade Index of Production. (Incomplete Results.)	London and Cambridge Economic Service Index of Production.	Volume of General Merchandise Carried by the Railways with Allowance for Growth of Motor Transport.	Volume of Exports.	
					British Isles.	United Kingdom.
1920.....	101	..	100	100	93	..
1921.....	75	..	76	76	85	..
1922.....	88	..	91	82	91	..
1923.....	93	..	95	94	98	..
1924.....	100	100	100	100	100	100
1925.....	99	..	99	101	100	99
1926.....	90	..	82	94	89	89
1927.....	105	107·5	102	107	103	102

It will also be shown in the reprint that the trend of the index of national prosperity is in general agreement with the evidence afforded by the *per capita* consumption of meat and beer.

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